इंटरनेट मानक

Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

"जानने का अधिकार, जीने का अधिकार"
Mazdoor Kisan Shakti Sangathan
"The Right to Information, The Right to Live"

"पुराने को छोड नये के तरफ"
Jawaharlal Nehru
"Step Out From the Old to the New"

IS 13351 (1992): Thoriated tungsten wires and rods [MTD 9: Lead, Zinc, Cadmium, Tin, Antimony and their Alloys]

"ज्ञान से एक नये भारत का निर्माण"
Satyanarayan Gangaram Pitroda
"Invent a New India Using Knowledge"

Act Number 22 of 2005
The Indian Parliament
RIGHT TO INFORMATION

Made Available By
Public.Resource.Org

"ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है"
Bhartṛhari—Nītiśatakam
"Knowledge is such a treasure which cannot be stolen"

BLANK PAGE

BRUTUM FULMEN

IGNORANTIA JURIS NON EXCUSAT

PROTECTED BY COPYRIGHT

IS 13351 : 1992
(Reaffirmed 1997)

भारतीय मानक

थोरियेटेड टंगस्टन तार एवं छड़ें – विशिष्टि

Indian Standard

THORIATED TUNGSTEN WIRES AND RODS — SPECIFICATION

UDC 669·27-426 : 621·385

© BIS 1992

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

February 1992 **Price Group 2**

Special Metals and Alloys Sectional Committee, MTD 27

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Special Metals and Alloys Sectional Committee had been approved by the Metallurgical Engineering Division Council.

Thoriated tungsten wires and rods are intended for use as directly heated cathodes for thermionic emission in vacuum tubes. Thoriated tungsten rods also find wide application as electrodes for TIG welding.

Addition of Thoria (ThO_2) having smallest particle size and homogeneous distribution increases the high temperature strength, recrystallization temperature and decreases electron work function of tungsten considerably.

This standard has been prepared as a guide for the manufacturers and users of thoriated tungsten wires and rods for obtaining the desired characteristics.

In the preparation of this standard, necessary assistance has been obtained from ASTM F 288-1981 'Tungsten wire for electron devices and lamps', issued by the American Society for Testing and Materials (USA).

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

THORIATED TUNGSTEN WIRES AND RODS — SPECIFICATION

1 SCOPE

This standard covers the requirements of thoriated tungsten wires and rods containing 2 percent thoria which are intended for use in vacuum tubes and for TIG welding.

2 REFERENCES

The Indian Standard IS 1387 : 1967 'General requirements for the supply of metallurgical materials (*first revision*)' is a necessary adjunct to this standard.

3 TERMINOLOGY

3.1 For the purpose of this standard, the following definitions shall apply.

3.1.1 *Wire*

The term wire as used in this specification applies to all drawn material that is spooled or coiled, and to short cut lengths 0·51 mm or less in diameter.

3.1.2 *Rod*

The term rod as used in this specification applies to centreless ground material above 0·51 mm in diameter, in short cut lengths or random cut lengths.

4 SUPPLY OF MATERIAL

The general requirements relating to the supply of this material shall conform to IS 1387 : 1967.

5 CHEMICAL COMPOSITION

5.1 The chemical composition of thoriated tungsten wires and rods when determined by gravimetric or spectro-chemical analysis shall be as indicated below:

Thoria, percent	: 1·75 to 2·10
Tungsten, percent	: Remainder

5.1.1 Thoria content shall be determined in accordance with **A-1**.

6 PHYSICAL PROPERTIES

6.1 The ductility requirements for thoriated tungsten wires shall be as indicated below.

6.1.1 *Wire up to 75 mg/200 mm Inclusive*

Six one-metre lengths shall be tested in accordance with **A-2**. The wire shall not break more than two times in the six tests or as agreed to between the purchaser and the manufacturer.

6.1.2 *Wire over 75 mg/200 mm*

Thirty successive turns of the wire when completely and closely wound around the mandrel it shall be free of splitting or cracking when tested in accordance with **A-2** and examined at a magnification of 30 X.

6.1.3 *Special Ductility Requirements*

Wire for certain applications may require special ductility as agreed to between the purchaser and the manufacturer.

6.2 The ductility of wire shall be determined in accordance with **A-2**.

7 FINISH

7.1 The thoriated tungsten wires and rods shall be supplied in finishes, depending upon the size as indicated in Table 1.

Table 1 Forms of Supply Finishes and Sizes

Form	Finish	Size
Wire	Black, as drawn Chemically cleaned, Chemically cleaned and stress-relieved Reducing atmosphere cleaned and annealed Etched and Electropolished	Diameter up to and including 0·51 mm
Rod	Centreless ground	Diameter over 0·51 mm

7.2 Lengths of supply for wires and rods shall be as given below:

Wires	Diameters up to and including 0·51 mm	In continuous lengths wound on spools, the minimum mass of wire in each spool shall be 50 g.
Rods	Diameters over 0·51 mm	The rods shall be supplied in length of 150 mm to 1 000 mm (Tolerance: ± 5 mm)

7.3 Straightness

When wires are ordered as straightened, straightness of wire 3·0 mg/200 mm and larger shall be specified as the radius of curvature or camber of a given length of wire as agreed to between the purchaser and the supplier. For wire under 3·0 mg/200 mm alternate methods for straightness requirements may be used as agreed to between the purchaser and the supplier.

Rods shall not deviate from straightness by more than 2 mm when measured at the centre of any 1 m length.

7.4 Coiling and Spooling

The wires shall be supplied coiled in plastic spools free from open seams or projections which might tangle the wire during winding. The wire shall be supplied in a single continuous length and wound smoothly with no loose turns. There shall be no piling up of turns such as to prevent free unwinding or cause kinks or bends when the wire is unwound from the spools. The outer end shall be attached firmly to the spool by suitable means.

7.4.1 Spool and band dimensions shall be as shown in Table 2. Except for wires in the finish etched, and electropolished condition, no spools or bands in any one shipment shall contain less than 300 m of wire for sizes up to 35 mg/200 mm; not less than 200 m of wire between 35 and 50 mg/200 mm, and not less than 100 m between 50 and 100 mg/200 mm. For wire sizes above 100 mg/200 mm, each spool or band shall contain not less than 50 g minimum mass of wire.

8 FREEDOM FROM DEFECTS

8.1 Wires

The wires shall be smooth, free from twists, bends, kinks, curls, dents, swaging marks, scratches, die-marks, laps, seams, splits, slivers, inclusions, bumps, pits, grooves, cracks and other physical defects when examined at a magnification of 30 ×. The wires shall also be free from graphite, grease, oil, dirt, oxide stains, scales and other surface defects.

8.2 Rods

The rods shall be smooth, free from twists, bends, kinks, curls, dents, swaging mark, scracthes, die-marks, laps, seams, splits, slivers, inclusions, bumps, pits, grooves, cracks and other physical defects when examined at a magnification of 30 ×. The rods shall also be free from graphite, grease, oil, dirt, oxide, stains, scales and other surface defects.

9 DIMENSIONS AND TOLERANCES

9.1 Wires and Rods

The permissible variations in mass and size for wires and rods shall be in accordance with Table 3.

9.2 The mass of thoriated tungsten wire and rod (density 18·50 g/cc) shall be calculated using the formula indicated below:

$$\text{Mass in mg/200 mm} = (\text{Diameter in mm})^2 \times 2906$$

9.3 Out of roundness of wire or rod over 0·51 mm in diameter shall be within 5 percent of the maximum diameter, when measured by a method as agreed to between the supplier and the purchaser.

A reference method for testing out-of-roundness appears in **A-3**.

Table 2 Size of Spools, Band or Coil

(*Clause* 7.4.1)

Flange or Head Diameter mm	Mandreal or Hub Diameter mm	Inside or Hole Diameter mm*	Traverse mm
18 to 20	15 to 16	11 to 12	11 to 12
19 to 20	16 to 17	6 to 7	16 to 17
48 to 60	29 to 41	9 to 10	19 to 25
89 to 118	76 to 105	9 to 10	15 to 17
102 to 121	98 to 102	89 to 98	19 to 25

*Except on conical chamfered centre wound spools.

Table 3 Permissible Variations in Mass and Size for all Types of Wires and Rods

(*Clause* 9.1)

Mass of Wire, mg/200 mm	Dimensional Tolerances	Size Uniformity Within a Spool
Up to 0·36	± 0·02 mg/200 mm	0·02 mg/200 mm
Over 0·36 up to and including 0·67	± 0·03 mg/200 mm	0·02 mg/200 mm
Over 0·67 up to and including 2.0	± 3 mass percent	0·02 mg/200 mm
Over 2·0 up to and including 760·0	± 3 mass percent	1 mass percent
Over 760·0	± 1·5 percent of diameter	

10 PACKING AND MARKING

10.1 Each shipment shall be packaged in such a manner that it will be protected from damage in transit or in handling. Dusty and linty material or any paper wrapping material containing ingredients that would, in any way, be injurious to the tungsten shall not be used for packaging.

10.2 Each spool or band shall be marked with the indication of the source of manufacturer, description of the material, diameter, length in metres, net mass, lot number and the date of manufacture.

10.3 The material may also be marked with the Standard Mark. Details may be obtained from the Bureau of Indian Standards.

11 BASIS OF ORDERING

Orders for wire and rod to this specification shall include the following information:

a) Length in metres, or quantity for cut lengths;

b) Straightness;

c) Finish;

d) Mass or diameter and tolerance; and

e) IS specification number.

12 REJECTION

12.1 Any spool of wire, length of rods, or individual cut pieces not conforming to the specified requirements may be rejected. If 15 percent or more of the spools of wire, lengths of rod, or cut pieces in any lot do not conform to the specified requirements, the entire lot may be rejected.

12.2 The purchaser shall return rejected material in a suitable container for shipping, the original if possible, so that it may arrive at the manufacturer's plant in the same condition as it left.

ANNEX A

(*Clauses* 5.1.1, 6.1.1, 6.1.2 *and* 6.2)

A-1 DETERMINATION OF THORIA CONTENT

Transfer approximately 0·5 to 1·0 g of the wire (weighed to the fourth decimal place) to a clean porcelain boat. Place the boat in the combustion tube and bring the temperature up to 600° to 700°C. While the furnace is being brought to that temperature, pass a slow stream of air through the tube. When a temperature of approximately 600°C has reached inside the tube, introduce a flow of hydrochloric acid (HCl) gas along with the air. HCl gas can be produced by dripping, from a separating funnel concentrated sulphuric acid on sodium chloride in a flask: A rate of approximately three bubbles of HCl gas per second has been found satisfactory. Maintain a temperature of 600°C to 700°C and continue the flow of HCl gas air and until all the tungsten has been volatilized and only the white powder of thoria remains. In the ordinary carbon furnace two samples can be run simultaneously. The approximate time for volatilization is 5 h. The thoria may be transferred to a balance pan for weighing, or weighed in the boat. If it is weighed in the boat, the weight of the boat should be determined both before and after the heating period, to correct for any loss of weight by the boat during its stay in the furnace. Calculate the thoria content as follows:

$$\text{Thoria, percent} = \frac{\text{Mass of thoria (mg)} \times 100}{\text{Mass of samples (mg)}}$$

A-2 DETERMINATION OF DUCTILITY OF THE WIRE

A-2.1 Wire up to 75 mg/200 mm inclusive

Draw the wire over a 90 degree steel bar edge having a radius approximately equal to the diameter of the wire to be tested. Hold the wire against the edge of the bar with thumb and draw the wire at an angle of 45 degree to the bar edge at a rate of approximately 1 m/sec until the tension on the wire is sufficient to cause a tight helical coil to be formed after the tension is released.

A-2.2 Wire over 75 mg/200 mm

Wind 30 successive close-wound turns completely around mandrels of sizes as specified in Table 4.

Table 4 Ductility Test Conditions for Wires

Wire Diameter mm	Mandrel Diameter mm	Forming Temperature °C
0·17 to 0·25 including	1·02	650
Above 0·25 up to and including 0·38	1·57	700
Above 0·38 up to and including 0·51	3·18	800
Above 0·51 (for each 0·13 mm diameter add 1·57)		800

A-3 MEASURING OUT-OF-ROUNDNESS

A-3.1 For Wire under 0·25 mm in Diameter

Hold the wire in a rotating device designed to turn the wire about its longitudinal axis between the anvils of the measuring device.

A-3.2 For Wire between 0·25 to 1·5 mm in Diameter

Hold one end of the wire in a small pin vice or between the fingers and rotate it between the measuring anvils. One end of the wire may be turned up to form a flag so that the degree of rotation may be observed.

With a wire specimen between the anvils, retract the sensing anvil before each rotation of the wire and lower it again on to the specimen after the rotation is stopped. With heavier wire, having a degree of curvature, place the concave side of the curved surface against the fixed anvil and rotate the specimen a maximum of 180°, between points where the plane of curvature is parallel to the plane of the fixed anvil face.

Make sufficient readings to determine the minimum and maximum diameter of the material. Determine the extent of out-of-roundness by subtracting the minimum diameter from the maximum diameter reading. If the percent of out-of-roundness is required, calculate it as follows:

$$\text{Out-of-roundness, percent} = \frac{(\mathit{Max}\ \text{dia} - \mathit{Min}\ \text{dia})}{\mathit{Max}\ \text{dia}} \times 100$$

Standard Mark

The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act, 1986* and the Rules and Regulations made thereunder. The Standard Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well defined system of inspection, testing and quality control which is devised and supervised by BIS and operated by the producer. Standard marked products are also continuously checked by BIS for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

Bureau of Indian Standard

BIS is a statutory institution established under the *Bureau of Indian Standards Act, 1986* to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Copyright

BIS has the copyright of all its publications. No part of these publications may be reproduced in any form without the prior permission in writing of BIS. This does not preclude the free use, in the course of implementing the standard, of necessary details, such as symbols and sizes, type or grade designations. Enquiries relating to copyright be addressed to the Director (Publications), BIS.

Revision of Indian Standards

Indian Standards are reviewed periodically and revised, when necessary and amendments, if any, are issued from time to time. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition. Comments on this Indian Standard may be sent to BIS giving the following reference:

Doc : No MTD 27 (3580)

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters :

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones : 331 01 31, 331 13 75

Telegrams : Manaksanstha
(Common to all Offices)

Regional Offices :		Telephone
Central :	Manak Bhavan, 9 Bahadur Shah Zafar Marg NEW DELHI 110002	311 01 31 331 13 75
Eastern :	1/14 C. I. T. Scheme VII M, V. I. P. Road, Maniktola CALCUTTA 700054	37 86 62
Northern :	SCO 445-446, Sector 35-C, CHANDIGARH 160036	53 38 43
Southern :	C. I. T. Campus, IV Cross Road, MADRAS 600113	235 02 16
Western :	Manakalaya, E9 MIDC, Marol, Andheri (East) BOMBAY 400093	6 32 92 95

Branches : AHMADABAD, BANGALORE, BHOPAL, BHUBANESHWAR, COIMBATORE, FARIDABAD, GHAZIABAD, GUWAHATI, HYDERABAD, JAIPUR, KANPUR, LUCKNOW, PATNA, THIRUVANANTHAPURAM.

Printed at Printwell Printers, Aligarh, India